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PREHISTORIC BEAN REMAINS FROM CAVES IN THE OCAMPO REGION OF TAMAULIPAS, MEXICO

BY

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DURING the winter of 1954, under the auspices of the Botanical Museum of Harvard University, the American Philosophical Society, the American Academy of Arts and Sciences and the National Museum of Canada, the junior author undertook an archaeological survey and excavations in Tamaulipas, Mexico. The primary purpose of this investigation was to obtain specimens and information pertaining to the origin, development and diffusion of prehistoric agriculture in the New World. One of the important foods domesticated and dispersed prehistorically was beans. This report is concerned with the bean remains found in the excavations.

Tamaulipas is the northeasternmost state of Mexico and is situated along the Gulf Coast. The southwestern portion of this state was the area surveyed. This region shows considerable range in topography and vegetation from east to west. The eastern boundary is the wide flat meandering Guajalejo River valley which has a tropical vegetation extending up from the south. West of this valley, running north and south, lies the first ridge

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of the Sierra Madre mountains. This rises to a height of 3,000 feet and is covered by a tropical rain forest with large pines on the summits. Further to the west, the valleys gradually become narrower and more canyon-like, with a more xerophytic vegetation in which maguey, cactus, mesquite and chaparral predominate. The mountains are higher (over 5,000 feet) with a thin cover of pines on their rocky summits. In this region we were fortunate enough to find three dry caves with stratified deposits representing eight cultures, associated in the main with abundant, preserved food remains (including beans).

We must first describe the archaeological findings in order to present an adequate background for an analysis of the bean remains. The sequence is based upon stratigraphy from three caves which is in part confirmed by Carbon 14 dates (see Table I). Study of the artifacts from the various occupation levels in the caves revealed similar sequential cultural complexes. Romero's Cave (Tm c 247) had sixteen occupation levels and a few artifacts below them belonging to the Infiernillo, Ocampo, Guerra, Mesa de Guaje, Palmillas, San Lorenzo and San Antonio complexes. Valenzuela's Cave (Tm c 248) contained nine stratified layers belonging to the Infiernillo, Ocampo, Flacco, San Lorenzo and San Antonio complexes, all of which had associated vegetal materials. Ojo de Agua Cave (Tm c 274) had twelve occupations and cultural remains representing the Infiernillo, Flacco, Palmillas and San Lorenzo complexes. Only the upper Palmillas level had preserved food materials. The accompanying chart Table I illustrates the dating and correlation of the stratigraphy of the three caves.

The Sequence of Cultural Phases

In briefly summarizing the cultural complexes, we

TABLE I

Cultural Phase	Estimated dates in years ago	Tm c 247 Occ. layer	Tm c 247 C. 14 date	Tm c 247 C. 14 No.	Tm c 248 Occ. layer	Tm c 248 C. 14 date	Tm c 248 C. 14 No.	Tm c 274 Occ. layer	Tm c 274 C. 14 date	Tm c 274 C. 14 No.
San Antonio	260	16			9					
		15								
	500									
San Lorenzo		14						12	520±200	M-501
	900	13			8			11		
	1100									
		12						10		
Palmillas								9		
	1800	11	1720±150	M506				8		
La Florida	2400									
		10	3440±250	M505						
Mesa de Guaje	3400	9	3650±250	M505a						
		8								
		7								
		6	4730±300	M504						
Guerra	3800	5								
					7	3945±334	c____	7		
								6		
								5		
								4		
								3		
Flacco	4300							2		
		4	4580±350	M503						
		3								
		2								
		1	5230±350	M502						
					6	5650±350	M497			
					5					
Ocampo	6000				4					
	7000									
					3					
		1a			2	8200±450	M498			
								1	8540±450	M-500
Infiernillo	9000				1					

shall emphasize what we know of the subsistence and domesticated plants utilized, with only a mention of the more diagnostic artifact types.

The people of the Infiernillo Phase were nomadic family bands of wild plant collectors who did some hunting. Nevertheless, they utilized the domesticated gourd (*Lagenaria siceraria*) and the pumpkin (*Cucurbita Pepo*). The seeds of the pumpkin, however, are extremely small and it must have been close to the hypothetical wild form if it were not actually wild. Other plants collected, which could have been domesticated, included runner beans, chili pepper and opuntia. These species, however, represented only a small portion of the diet which was composed mainly of a wide assortment of wild plants. Among the distinctive artifacts we might list Fuegian nets, loop-twine and Fuegian baskets, flake choppers, pebble smoothers, checker-woven mats with oblique corners, short incipient contracting-stemmed and small diamond-shaped projectile points, fire tongs and digging sticks. We could further enumerate a number of more general cultural traits such as several kinds of choppers, side scrapers and scraping planes, round-based points and knives, atlatl and dart fragments, twilled mats and different kinds of string with various knots in them.

Ocampo had more foodstuffs and many more artifacts. The people of this stage were semi-nomadic plant collectors who did a little hunting and who gained a small part of their sustenance from domesticated plants. Their incipient agriculture included pumpkins (*Cucurbita Pepo*), gourds (*Lagenaria siceraria*), common beans (*Phaseolus vulgaris*) of two varieties, chili peppers (*Capsicum*) and, possibly, corn. We say "possibly corn," because, although we found no cobs or kernels in the refuse, an examination of feces from these levels revealed minute particles of cobs and leaves. This discovery suggests that

small primitive or green ears had been masticated and digested, leaving no cob or kernel remains in the refuse. Opuntia and runner beans also served as food. Distinctive artifacts for this complex are Fuegian and full-turned coiled nets, three-over-three twilled baskets, twilled and plaited mats, large triangular and leaf-shaped atlatl dart points, interlocking loop-coiled baskets, gouges, antler hammers, and a wide variety of larger scrapers (planes) and choppers. There likewise occurred more general traits, such as different kinds of string and knots, mats, bone awls, wooden wedges, dart points, bifacial knives, shell beads, mortars and gourd containers.

The Flacco Phase developed directly from the Ocampo. The people of this phase were also semi-nomadic food-gatherers, but they depended more on incipient agriculture than on hunting or trapping of game. Squash, gourds, corn, chili pepper, two kinds of common beans (found in the feces), *Panicum*, amaranths, and runner beans made up apparently about twenty percent of their diet. Long contracting-stem and indented-base points, mullers and mortars, spokeshavers, Fuegian baskets, spring traps and snares, twilled baskets, simple coiled bags and elongate chisels are diagnostic traits. Though most of the heavy stone scrapers and choppers of Ocampo are not present, the more general traits continue to occur.

With the development of the semi-sedentary Guerra peoples, there occurred a fundamental shift in diet. While they still collected a vast amount of wild plants, agriculture furnished most of the energy-producing foods. The most prevalent remains are corn cobs (Bat Cave race). In addition, gourds, several varieties of pumpkin, squashes (*Cucurbita moschata*), peppers, common beans, amaranths, *Panicum* and cotton occur. The cave occupations, and also the survey, indicate the possibility that these people occupied small villages. Split-

stitch, interlocking loop, and simple stitch baskets built on a bundle foundation, small tear-drop, triangular and corner-notched dart points, rabbit sticks, leather huarches, and other objects, mullers and manos, a twined woven robe, decorated mats with woven borders, as well as a wide variety of different kinds of string, and more general artifacts give this culture a distinctive aspect.

Mesa de Guaje is very similar to the previous culture, but most of the nets and baskets have been replaced by plain weave cotton fabrics and plain black and brown pottery. Scrapers and flint tools are very rare; straight-stemmed points occur for the first time, as do manos and metates made of volcanic tufa, obsidian blades, clay disks, atlatl bunts and knotless netting. The Mesa de Guaje people definitely lived in villages. In terms of nutrition, probably more than half of their food was derived from agricultural products, the rest from wild plants. Corn is the main product and much of it shows teosinte introgression; actual grains of teosinte were found. In addition to beans (two varieties), gourds, squash, pumpkin, amaranths, peppers, cotton and sunflower seeds were present.

The next phase, called La Florida, was recognized in the survey, but did not occur in the caves. It is typical of the Late Formative of Mexico, with hand-modelled figurines, stemmed points, corner-notched points, prismatic blades, pottery bowls with tripod feet and stone-faced pyramids around plazas.

The following culture, Palmillas, represents the cultural apogee of the region. Furthermore, it represents the period of greatest diversity in agriculture. The greatest variability of pumpkins occurred at this time, as well as of gourds, warty squash (*Cucurbita moschata*) and walnut squash (*Cucurbita mixta*). A number of races of maize are present together with grains of teosinte. Three

varieties of common beans are found as well as lima and runner beans. In addition to these plants, *Manihot dulcis*, amaranth, chili, *Panicum*, sunflower, *Nicotiana* and cotton occur. In bulk, these species represent almost half the plant material found; in terms of food value, however, they represent a much larger proportion. Archaeologically, this phase is represented by a mass of material and traits. Only a bare minimum of the diagnostic artifacts will be mentioned. These include corner-notched arrow and dart points, serrated corner-notched points, engraved red, brown, and black pottery, packboards with net centers and wooden rims, complicated woven mats and cotton cloth, platform pipes and cane cigarettes, mold-made figurines, polished celts, circular pyramids and house platforms, as well as many other stone architectural features.

Though the sedentary agricultural San Lorenzo is obviously derived from Palmillas, there seems to be a short gap in the sequence and a degeneration in culture and agriculture. While all the kinds of cucurbits and beans appear, there is less variability. There are also only one or two races of corn, no teosinte, and only amaranths, peppers, cotton and tobacco. The bow and arrow, and a considerable range of arrow-point types appear; the pottery is crude — burnished, brushed and corrugated ware; the mats are decorated with colors; split-stitch bundle foundation baskets are plain; decorated cotton double-cloth occurs, and a number of small crude end-scrapers.

The San Antonio culture represents an even further degeneration, though the people of this phase seem to have been sedentary agriculturists living in "ranchos." Corn was apparently of a single race; there are only four kinds of beans. Cucurbits (*Cucurbita Pepo* and *C. moschata*), gourds, cotton and tobacco still occur. Many of

the artifacts are like those of San Lorenzo, but new point and pottery types occur as do large choppers and scrapers. Historic goods were present in some levels, and the woven twilled mats, coiled nets and cloth were much simpler.

Though the culture phases mentioned above seem to represent a unilinear development, the area, situated on the northern peripheries of Meso-America, must have had many influences at different periods from the south. It is believed that this peripheral region reflects, perhaps with some time-lag, the general sequence of agricultural practices for all of Middle America. Its geographical position just north of Meso-America indicates that it is a key area for the understanding of diffusion of agriculture into North America.

The study of our bean remains from the Tamaulipas caves, which seems to bear out these generalizations, also has considerable bearing on the solution of the problem of the origin and dispersal of prehistoric beans in the New World.

Identification of Materials

The materials examined consist primarily of desiccated and uncharred bean pods and fragments of pods. Seed remains are few and often fragmentary. Since most of the materials mentioned in this paper are pods, a brief discussion of the nature of legumes will be helpful.

In the *Leguminosae*, gross morphology of the fruit may be diagnostic in species-determination and is useful in delineating varieties of polymorphic species such as *Phaseolus vulgaris*. The legume or pod is a single carpel with two identical valves dehiscing on dorsal and ventral sutures. At the basal end, these elongate valves diverge from a pedicel and terminate at the apex in a straight or curved tip. Behavior of the pods at dehiscence is related

to their anatomy and may differ markedly in different varieties. When the fruit is mature and dry, the valves split along dorsal and ventral sutures after which they may simply separate or they may twist to varying degrees. Twisting results in dislodgment of seeds and probably aids in their dissemination. The twist of one valve is the mirror image of the other, and the twist of both is the result of a shortening of certain fiber-cells in the pod-wall.

In the production of beans which are threshed after the pods and seeds mature and dry on the plants, it is essential that the pods be of the type which do not dehisce violently with the consequent scattering of the seeds prior to threshing. The manner of dehiscence is of little importance in varieties which are customarily harvested during damp weather or which are used in the green stage.

Explosive scattering of seeds probably occurs in all wild species of the genus *Phascolus* and the loss of this characteristic must have been one of the important features of domestication and variation in beans.

The pods, and other vegetal debris examined, had been placed in separate packets, according to the site of collection, culture and occupation level. When the relative quantities of materials present in each occupation level had been estimated, tentative species-identifications were made. Many of the twisted and folded pods were extended and pressed after softening in warm water with a detergent to facilitate their identification.

Phascolus vulgaris (common beans) and *P. lunatus* (the small seeded or sieva group of lima beans) were recognized on the basis of their gross morphology. *P. coccineus* (runner beans) pod fragments were at first classified only as leguminous remains, probably of a species of *Phaseolus* or a closely related genus. These remains of *P. coccineus* were later identified on the basis of the hilum

Plate VI

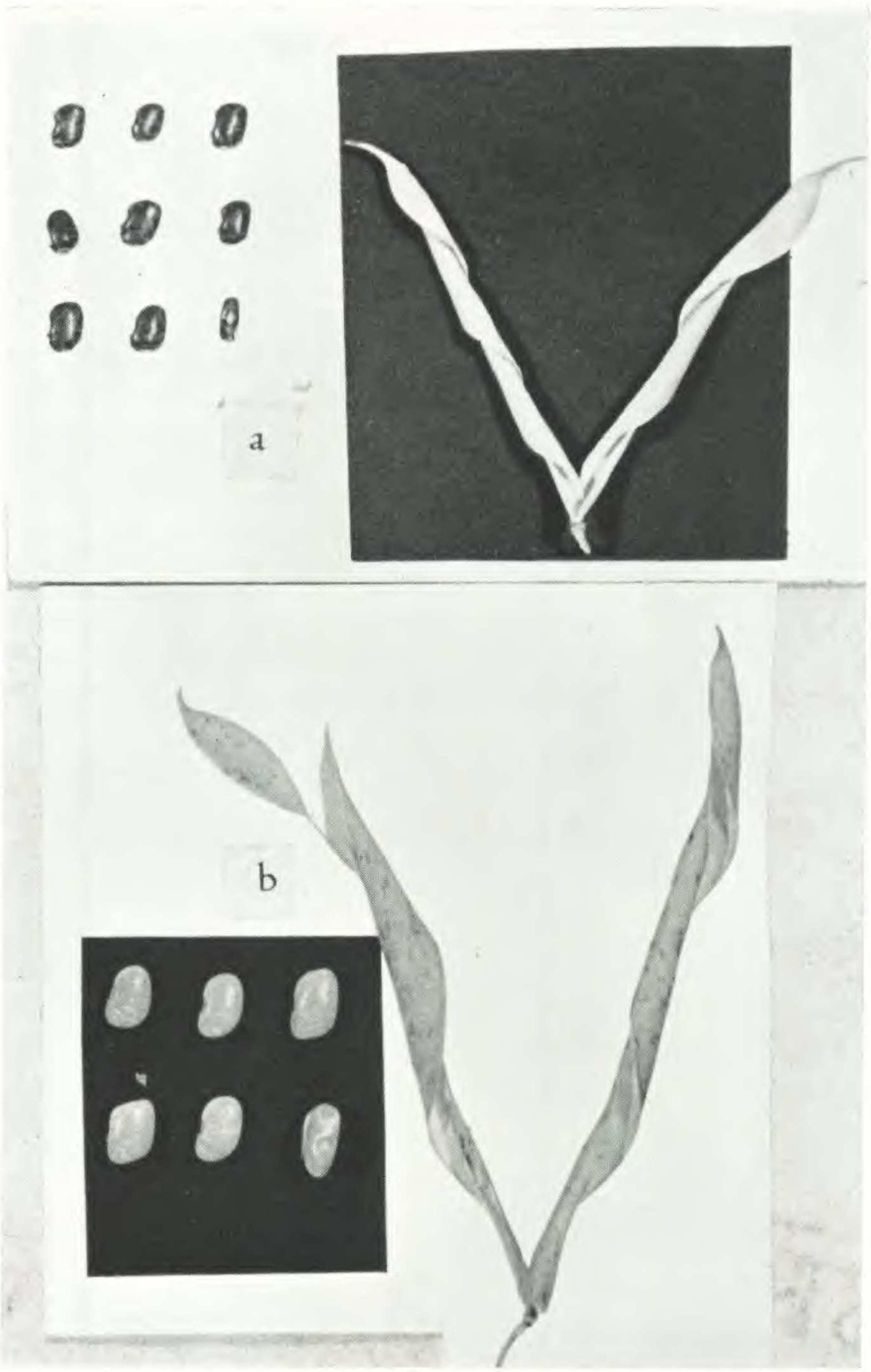

Plate VI. a, "Indigenous *Phaseolus vulgaris*." From plants grown at Lombard, Illinois by H. C. Cutler; original collection by O. W. Norvell, 14 km. north of Iguala, Guerrero. Natural size. b, "Wild *Phaseolus vulgaris*." Collected by G. F. Freytag on slopes of volcano of Colima, Jalisco. Natural size.

characteristics of a single seed coat fragment still attached to a pod valve, and the dimensions of one almost complete valve which correlated in form and texture with the previously unidentified leguminous type. Although the hilum in question is within the size range of *P. lunatus*, the separate ridges of the caruncle excluded the possibility of its being a lima bean. The hilum characteristics of this fragment are similar to those of a rather large common bean, but the dimensions and the fibrous to almost woody nature of the associated valve are similar to *P. coccineus* pods.

The possibility that this material pertained to some other species not known as a domesticate was not overlooked. Through the courtesy of Dr. Frederick G. Meyer, then at the Missouri Botanical Garden, it was possible for the senior author to examine a list of species compiled from the extensive plant collection of Dr. Meyer and Dr. R. L. Dressler. Specimens of legumes appearing in their list and which might have fruits similar to the archaeological fragments were examined in the herbaria of the Missouri Botanical Garden and the Chicago Natural History Museum. None was found to correspond to the material in question. By elimination, then, as well as by positive characteristics, the identification of *Phaseolus coccineus* was verified.

Variation in the *Phaseolus vulgaris* pods indicated their division into three types, each of which is described below. These types are to be considered as of coordinate standing with the typology presented for Southwest United States beans by Kaplan (1956). That is, in the absence of diagnostic characters which can be obtained only from the growing plants and complete herbarium specimens, the infraspecific types are without formal taxonomic standing.

Description of Types

Pod characteristics are summarized in Table III; the types discussed below have been given descriptive names and are numbered in sequence with archaeological beans described elsewhere (Kaplan, 1956).

Yellow seeded bush, C 31. The bush habit is indicated by remains of two plants with fragmentary fibrous root systems diverging from the bases of stems bearing fruiting branches. The curved pedicels are 0.8–1.5 cm. long borne in pairs on 5–6 cm. peduncles. The pods would have been borne at 15 to 20 cm. above the soil surface and appear to be fewer than 10 per plant, although this could be highly variable. This variety was probably harvested by pulling up the entire plant, since many of the pods have remained attached to stem sections. In contemporary Mexico, bush beans are frequently harvested in this manner; the bundles of dried plants are stored in or near the habitation and threshed by beating on a mat as opportunity or need arises. The yellow to yellow-tan color of the rare seed coat fragments associated with the pods represents possibly a change in hue from cream.

This group includes thin-walled variants probably picked when young. Thick-walled variants are more common, particularly in the San Antonio phase; 20 of 26 fragments in one San Antonio packet are thick-walled. It is not possible to say whether this is a genetic variation or the result of growing conditions. Lesions which appear to be anthracnose (*Colletotrichum Lindemuthianum*) injuries are found occasionally on all types but are abundant on the thick-walled variants.

Black seeded bush, C32. The pods are moderately curved with thin and relatively non-fibrous walls. In the immature condition, the fruits of this type might have been useful as snap beans; displacement of the intersti-

TABLE II

DISTRIBUTION OF BEAN REMAINS

Culture	Tentative age years ago	*P. coccineus* valves	*P. vulgaris* valves				*P. lunatus* valves	Total in each culture
			C31	C32	C33	C33a		
San Antonio	200–500	1	40		35			76
San Lorenzo Occupations 13,14,15,16	500–900	21	296	45	111	4	3	480
Palmillas	1100–1800	11	206		14		1	232
Mesa de Guaje	2400–3400		16		3			19
Guerra	3400–3800		1					1
Flacco	3800–4300	13						13
Ocampo (Portales)	4300–6000	4	5		1			10
Infiernillo	7500–9000	14						14

tial parenchyma tissue, however, shows that the seeds were mature when harvested. A single pod of this type was found containing three small black seeds (Table III). The non-twining shoots on which pods have persisted indicate this to be a bush variety probably harvested in a manner similar to that suggested for the previous type. In contrast to all other beans described here, the valves of almost all of the "black seeded bush" type are joined at the base and attached to the pedicel.

Long pod, C 33. The pods are curved but show little variation in breadth from base to tip, that is, there is little tapering; nor is there constriction of the dry pods between the seed positions. Most of these valves are dark reddish brown in color and have a cartilaginous rather than fibrous texture when wet. An occasional pod is encountered with the pedicel and peduncle still joined; these are approximately 1 and 3 cm. long respectively. None of the fruiting branches is attached to a main stem, suggesting that "long pod" is vining and that harvesting involved the pulling of individual pods as is the common contemporary practice with pole beans. No seeds have been found attached to the pods. A few fibrous-walled variants of C 33 (C 33a in Tables II and III) are present with more seeds than the type and are correspondingly larger.

Discussion

Runner beans

Of greatest interest in this group of legumes is the occurrence of remains of *Phaseolus coccineus*, constituting the first definite archaeological record of this species (Kaplan, 1956). In contemporary agriculture, these beans are grown mainly in the highlands of Chiapas and the Valley of Mexico. From the Federal District to Querétaro, they are frequent, and further north they are

TABLE III

SPECIES AND VARIETAL CHARACTERISTICS

SPECIES & TYPE	POD CHARACTERISTICS					SEEDS			
	length cm.	dorso-ventral width cm.	twist of valves	no. seeds per pod	tip	length cm.	width cm.	thickness cm.	color
P. vulgaris									
C31	7–9	0.8–1.2	slight	3–6	short-straight	fragments only	—	—	yellow to yellow tan
C32	6–7.5	0.7–1.1	slight or none	5	straight to down-curved	9–1.0	0.6	0.4	black
C33	11–13.5	1	moderate	7	few intact fragile	—	—	—	—
C33a	13–15	1–1.5	moderate	8	few intact fragile	—	—	—	—
P. coccineus	greater than 11	1.5 or more	tight	—	none intact probably short and stout	—	—	—	dark, probably purple
P. lunatus	about 12	3	slight	—	none intact				

Plate VII

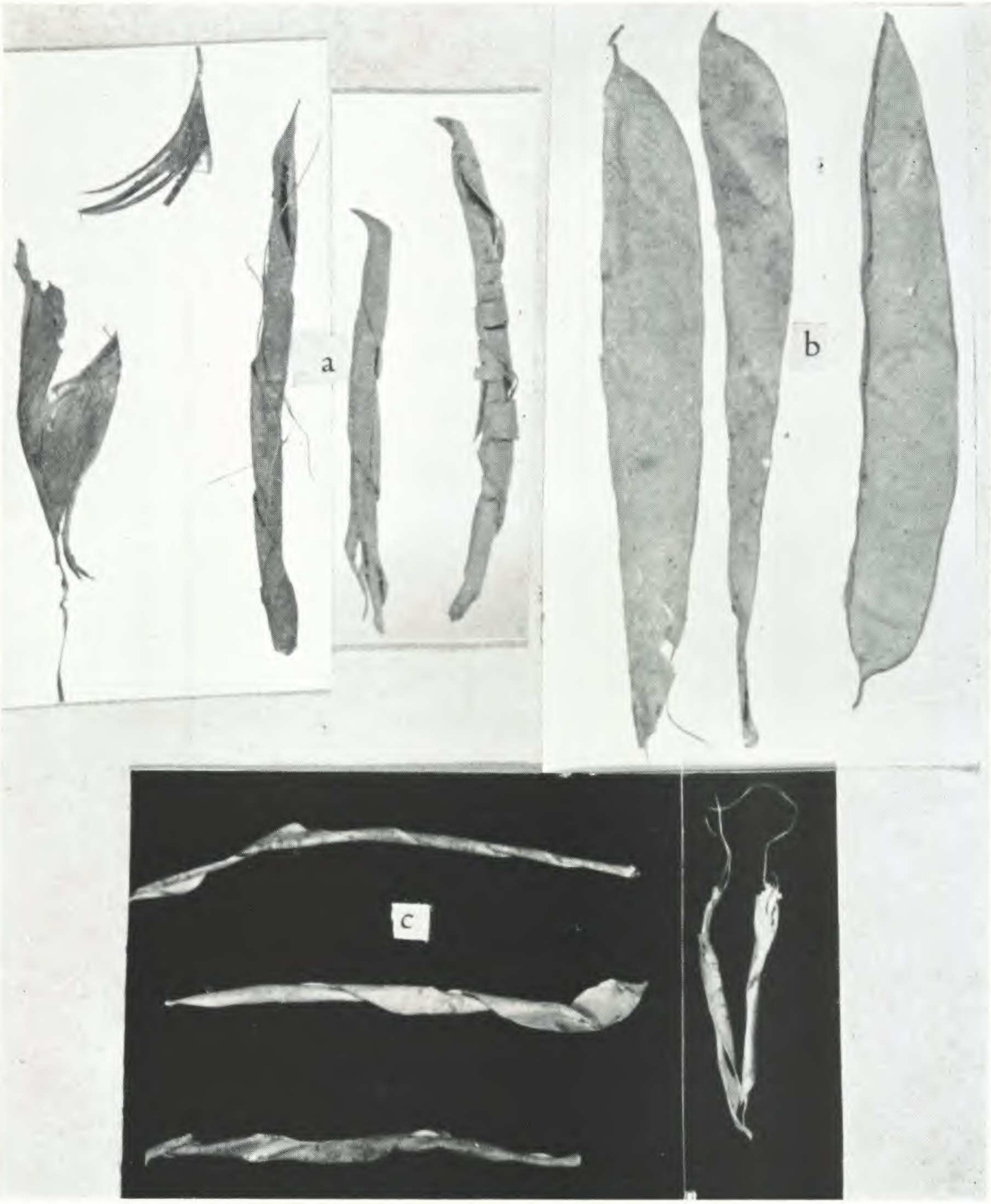

Plate VII. a, *Phaseolus coccineus*. Pod fragments from the Infiernillo and Ocampo cultures. Natural size. b, *Phaseolus vulgaris* (yellow seeded bush C31), three pod valves. From Palmillas culture. Natural size. c, *Phaseolus vulgaris* (long pod C33), pod fragments. Slightly less than one half natural size. From San Lorenzo Culture.

found only occasionally in Mexico and in the southwestern United States, where at least two varieties are cultivated by the Hopi. Runner bean use by the Hopi is almost certainly an historic introduction in view of their absence from archaeological sites thought to be associated with Hopi prehistory.

In July 1957, Kaplan briefly visited Ciudad Ocampo, below the Sierras in which the caves are situated, taking with him pods of the excavated *Phaseolus coccineus* and seeds of purple variegated and self-colored, white, modern runner beans. During the Sunday market, residents of Ocampo and others from villages higher up in the Sierras were shown the samples and asked to identify them. No one recognized the seeds or pods as belonging to either wild or cultivated plants with which they were familiar. It is safe to conclude that *P. coccineus* is not now utilized in the area in which the excavations were made.

The archaeological runner bean pods, notwithstanding their morphological similarities to modern types, differ from them in certain microscopic features. Some of these differences are quantitative and are related to cell-wall thickness and fiber-cell size. Furthermore, the archaeological pods are more tightly twisted than are those of modern cultivated varieties. Most striking is the abundance of sclerids or stone cells in the archaeological material as contrasted with their absence in modern runner bean pods. Although the reduction of sclerids in the domestication of fleshy fruits is of obvious adaptive value, it would not constitute a selective factor in the domestication of beans. Even if the pods were used in the green state, it is doubtful that the appearance of more edible varieties with fewer stone cells ever occurred as the result of human intervention. Since these stone cells affect qualities of pods which would be used in the immature state, any selection for their reduction would have re-

quired the application of rather advanced concepts of plant breeding probably not at the disposal of pre-Columbian peoples in the New, or, for that matter, in the Old World. It may be that the deposition of lignin to form stone cells is related to more general physiological processes which were subject to selective influences.

There is no apparent dissimilarity between early and later *Phaseolus coccineus* pods in this site. There are no pods which could be considered as intermediate in reduction of hard texture and fiber between the early Tamaulipas material and modern varieties.

There are, then, remains of *Phaseolus coccineus* pods, anatomically more primitive than modern types, in inhabited sites and corresponding at later occupation levels (see introduction and Table II) with definite evidences of agriculture. Several closely related problems remain to be solved. These are: the absence of *P. coccineus* from late Flacco to the beginning of Palmillas (Table II); the failure of the species to persist into historic times in this region; and its status as a domestic or wild plant during the periods of cave occupation.

The disappearance of runner bean use in Tamaulipas resulted probably from the effect of climatic change on plant distribution. Preliminary studies (MacNeish, in conversation) indicate that this region has passed through at least two warm climatic cycles. The earliest of these was presumably warm and moist, as its duration was marked by the presence of *Manihot* from late Flacco to about the beginning of Palmillas (see Table II). Runner bean remains are absent during this thermal period of more than 2000 years, although they are present both before and after. This absence cannot be explained by the prevalence of poor conditions for vegetal preservation in the caves, since cucurbit materials are abundant from this period (Whitaker, *et al*, 1957).

The reappearance of *Phaseolus coccineus* after the beginning of Palmillas suggests strongly the response of a wild rather than cultivated plant. We would hardly expect a cultigen absent for 2000 years to be reestablished merely with the return of favorable climatic conditions. Reintroduction is a possibility, but from where? The southwestern United States could not have been a source for reasons already noted. Plant migration from regions south of Tamaulipas would have been highly unlikely, since conditions there would have been even less favorable for the survival of a cultivated plant with cool temperature requirements. An indigenous plant, on the other hand, might have formed relic communities in protected locations becoming more generally distributed and available for human use at the end of the thermal period. A second thermal period might well have been the cause of the extinction of *P. coccineus* from this part of its natural range.

The hypothesis that *Phaseolus coccineus* may have been a wild rather than a cultivated plant in Tamaulipas is supported by the extreme age of the remains and their occurrence long before the practices of ceramic cooking and agriculture, and by the apparent lack of selection for pod characteristics found in modern cultivated varieties. If runner beans were present, but not domesticated, in Tamaulipas in spite of their being included in the gathered plant complex prior to and during agricultural times, another problem arises. Why would so useful a food plant be neglected as a domesticate in Tamaulipas but be brought into cultivation in Chiapas? The answer is to be found probably in the reaction of *P. coccineus* to the differing photoperiods in these widely separated areas of its range.

Allard and Zaumeyer (1944) studied the reaction of various leguminous plants to day-length. A daily expo-

sure to less than 13 hours of daylight resulted in an appreciable delay in flowering date of *Phaseolus coccineus* which was accompanied by tuberization of the root system. Longer day-lengths brought about earlier flowering, and tuberization did not occur. Chiapas, at about 16° North latitude with days of less than 13 hours of light during the growing season, corresponds to the delayed flowering-tuberized root situation, while Tamaulipas at about 23° North latitude has photoperiods of more than 13 hours during most of the growing season.

In the highlands of Chiapas, the fleshy roots of runner beans are eaten by Tzeltal Indians (fieldwork, 1957). If this be a retention of an early practice (as suggested by Edgar Anderson in conversation), then it is possible that domestication of runner beans was based upon root as well as seed use. Such a practice could not have occurred in Tamaulipas since tuberization does not occur because of the long-day, short-night condition.

The early presence of *Phaseolus coccineus* remains makes it advisable to examine any wild populations of bean species which are otherwise known only as cultivars. Kaplan has collected *P. coccineus* in a variety of situations, including pine and oak forests and deep *barrancas*, in Chiapas. None of these sites has been under cultivation in the memory of local inhabitants, but the strong tendency of this species toward perenniality leaves open the possibility that these plants are relics of cultivation. However, Ephraim Hernandez X. has stated (in conversation) that *P. coccineus*, and other closely related species, which are not escaped or relic cultivars do occur in Chiapas. Probably the most important related species is *Phaseolus polyanthus* Greenman which also seems to be planted with *P. coccineus* and reaches the markets with beans of this latter species. Oliver W. Norvell has noted such market mixtures in seed collections in the herbarium

of the Chicago Natural History Museum (herbarium accession numbers 981251 and 1119897). The caruncle ridges of this species are less distinctly separated than those of *P. coccineus*.

Concerning the distribution of *Phaseolus polyanthus*, Piper (1926) says only that the type specimen is from near Jalapa, Vera Cruz, where it was collected on a railway embankment (Greenman, 1907). Piper further notes that specimens which may be from wild *P. coccineus* plants have been collected near Puebla, Puebla; Monte Escobedo, Zacatecas; Saltillo, Coahuila; Tacuba, Mexico; San Juan Capistrano, Jalisco; Tumbalá, Chiapas; and Frajanco Santa Rosa, Guatemala. As yet, there is, unfortunately, not sufficient information concerning affinities and barriers between putative wild *P. coccineus* and wild possibly interbreeding species, and domesticated *P. coccineus* to draw any conclusions concerning systematic relationships.

Common beans

Types of *Phaseolus vulgaris* not generally distinguishable from modern cultivated varieties appear in abundance beginning with the Mesa de Guaje level, at about the same time that intensive agriculture and fired ceramic wares were introduced. Bean remains in non-agricultural, pre-pottery Ocampo and Guerra cultures are limited in number. This situation is similar to that in the Southwest, where in the Mogollon and Basketmaker–Pueblo regions the increase in bean remains is correlated with the introduction of pottery (Kaplan, 1956).

Common beans, appearing for the first time in the Ocampo culture, join the already established *Cucurbita Pepo* (Whitaker, *et al.*, 1957). Both of these plants antedate the appearance of corn. This is the only area in which common beans have been shown to occur prior to

corn and the early bean types persist into more recent archaeological times.

The presence of these bean types in early pre-pottery times followed by an expansion of their use with the introduction of pottery agrees with the hypothesis presented (Kaplan, 1956) to account for the remarkable constancy of bean types over long time spans in the Southwest. This hypothesis postulates that beans entered as domesticates very early, were sparingly cultivated until the use of pottery began and then the same, long established, well adapted varieties came into more general use.

Collections of specimens determined as wild *P. vulgaris* have been made by G. F. Freytag, O. W. Norvell, A. Burkart and others. The only published account of wild and cultivar affinities which goes beyond morphological comparison is that of Burkart and Brücher (1953). A wild *Phaseolus* species collected in Central and South America, and studied by these authors, has proven to interbreed with *P. vulgaris* and although the floral morphology is similar, differences in seeds, pods and leaves exist. As a result of their studies, revisions in the nomenclature of *P. vulgaris* L. were proposed by Burkart and Brücher (1953).

The various collections identified as wild *P. vulgaris* have all been vining types with seeds smaller than those encountered in most cultivated varieties. It seems that the determinate growth habit as well as increase in seed size and reduction of pod-shattering have been established under domestication.

Sieva beans

Small seeded limas, or sieva beans, were introduced late and never attained much importance. Their paucity here substantiates other evidence indicating that these

beans entered the southwestern United States from the west. Sievas appear in the Verde Valley and at Point of Pines, but not in the more easterly Mogollon and Basket-maker–Pueblo areas. With the study of additional remains in the future some relationship between southeastern United States and northeastern Mexico sievas may be shown.

Tepary beans

The absence of tepary beans (*P. acutifolius* var. *latifolius* Freeman) supports our present knowledge of their pre-Columbian and historic distribution. Bukasov (1930) and others have indicated a western distribution for contemporary tepary cultivation, while Carter (1945) has shown a spread of tepary cultivation from south-central Arizona to the north and east in late pre-Spanish times.

Summary

1. A total of 845 bean pod fragments from three archaeological cave sites in Tamaulipas, Mexico, were studied and identified. These remains consist of: *Phaseolus vulgaris* (3 domesticated types), *P. coccineus* (one nondomesticated type), *P. lunatus* (one domesticated type).

2. These beans are considered to be distinct from those occurring in prehistoric time in the southwestern United States.

3. It is thought that *P. coccineus*, although gathered as a useful wild plant, was not domesticated in this region because of non-tuberization of the roots under the photoperiod conditions of Tamaulipas.

4. *P. vulgaris* remains first appear with preagricultural materials 4300–6000 years ago and are the oldest com-

mon beans yet reported. They antedate corn but are later than squash in these sites. *P. coccineus* remains, the earliest of which are dated 7500–9000 years ago, constitute the only archaeological runner beans on record. *P. lunatus* remains are few and were present 500–1800 years ago.